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TECHNOLOGY ASSESSMENT OF ELECTRONIC COORDINATION AND FILING

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THIS REPORT HAS BEEN REVIEWED AND IS APPROVED

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I. Historical Review

Electronic coordination and filing can be thought of as a revolutionary way of doing office tasks that have been accomplished to date using paper. These tasks include the filing and retrieval of documents and the inter-office communications of notes and memorandums (all paper related tasks). Electronic coordination and filing is a fairly new technology that uses both mature and developing technologies to replace the existing paper systems. Typical office memos or notes can be replaced with electronic mail. Likewise, current paper storage methods, such as filing cabinets, can be replaced by electronic storage and filing.

Historical trends have shown the ability to store more data on a single media. For example, the 3.5" floppy started at 720 Kbytes, quickly jumped to 1.44 Mbytes, and soon will be in excess of 2 Mbytes. Users and application developers have been able to take advantage of the increased storage capacity and have started to push industry for more. This push is because of the increased number of documents, data, and information that is being stored electronically. Another trend has been for the cost per storage unit to decrease.

This assessment will be categorized into two broad areas: (1) electronic coordination, and (2) filing. Electronic coordination will include the sub-areas of electronic mail and message systems and group work technologies. Filing will include the sub-areas of storage methods and media and recall techniques.

II. Currently Available

A. Electronic Coordination

1. Electronic mail. There has been a tremendous growth in the use of electronic mail as a standard way of providing coordination. However, the largest problem facing electronic mail systems today is the large number of different systems. This has created islands of electronic mail. The technology is available to start to change this, however, the cost involved in removing or changing existing systems makes it prohibitive.

There is a move underway to standardize electronic mail using the X.400 standard and, when available, the X.500 directory service standard. Neither of these standards are in wide use today. [1] [2]

Another growing area is in the use of voice mail. This is an emerging technology. Voice mail is not in wide spread use today, but as new applications and decreases in cost occur the use will increase. Voice offers the ability to send and receive messages much like electronic mail, but without the additional hardwire (terminal) requirements. [3] The existing telephone networks already provide a maximum degree of connectivity between existing stations.

FAX use has exploded recently, however the technology is not new. The decrease in cost of FAX machines has lead to the increased use. This use will continue to increase with time, as FAX applications are added to an increasing number of existing PCs with FAX boards and applications to take advantage of the information.

With the increase in FAX usage, there may be a decrease in the number and use of telex-type devices. Increased use of electronic mail and voice mail will also reduce the dependence on telex. [4]

2. Work Group. Work Group applications are just beginning to appear. [4] These applications create a computing environment that fosters cooperation between individuals and groups. Examples are groups working on the same document, or individuals participating in electronic group decision making. [For more detail on group decision support systems see the Decision Support Systems Technology Assessment, AIRMICS Report, ASQBG-A-89-004.] The limitation on work group applications is connectivity. For example, for several individuals to work on a particular application, they must be connected on the same system. The limited use of work group computing will change as more distributed systems are created and individual user connectivity increases.

B. Filing

1. Storage. This area covers several different disciplines, including storage on various media, image processing, and hypermedia.

In the storage area there are two technologies that dominate, magnetic and optical. The magnetic media mainly consists of disk and tape storage. The amount of storage on a single disk or tape is ever increasing while the cost of each storage unit is decreasing. More and more vendors are producing

optical products, which, like their magnetic counterparts are decreasing in price.

Magnetic tape has been and continues to be the preferred method for long-term archival storage of electronic data and information. Magnetic tape offers a low cost per storage unit. The use of magnetic tape has been increasing as a storage media on smaller PCs or workstations. This will continue as more policies on backup and archival are enforced. As high-capacity floppy disks (10-20 Mbytes) appear in the next several years, they may take the place of the smaller streaming tape systems used today. For very large systems, tape will continue to be a cost effective storage technique. However, there may be more growth for the 1/4 inch cartridge as capacities increase. The standard 60 Mbyte tape will be replaced by the 125-150 Mbyte tapes and a 320 Mbyte tape is expected soon. [6]

Optical storage is a growing area. Experts predict optical storage products to account for 25% of the storage market by 1991 as compared to 7.9% of today's market. Optical systems are more robust than current magnetic systems, which will account for their continued growth in military and harsh commercial environments. Optical systems are more robust because they do not have the read-write head problems associated with magnetic drives and offer environmental stability. Optical drives can withstand wide ranges of temperature, pressure, and humidity. [7] There are some current problems with optical technology that must be solved. First is the lack of standards. Because of the lack of standards, each vendor produces his own standard. This results in the inability to use disks in multiple machines or sites with different drives. Standards need to be set for media, formats, logical file structures, and interfaces. [8] There are not a large number of applications that take advantage of optical technology. Finally, there is no hard data on how long a optical disk will last in archival storage. Current estimates predict 10-20 years. However, one manufacturer is now saying 50 years. [9]

The drives to read both optical and magnetic media are also receiving technology boosts. New technologies are making 100-200 Mbyte drives with 20 msec seek times available. [10] The number of manufactures producing erasable optical drives is increasing. Erasable optical drives provide high capacity and fast random access. IBM's entry into this market with their 3363 drive, with 200 Mbyte of removable recordable storage, has helped to promote growth in this market.

Microfilm will also continue to be a storage media. Current trends show that microfilm may be able to be integrated into other media, such as optical storage.[11]

Another storage media that is being examined, but not currently in wide spread use is digital paper. This technology, while currently more costly than magnetic or CD-ROM optical, may have use in the future. [12] Uses for optical storage are also increasing. The wide spread use of optical storage, except for archival purposes, will not occur until reliable and cost effective read-write optical disks and drives are available.

Hypermedia is a special application within the storage media. While envisioned 20 years ago, only now is the hardware technology available to take advantage of this concept. The first hypermedia products are just beginning to appear. As more products appear and methods for moving existing data and databases to a hypermedia format are derived, there will be sufficient reasons to take advantage of this technology. Because of changes required, we will not be able to take advantage of this technology for several years. [13]

Like hypermedia, image processing is a growing field. Image processing is closely aligned with the desktop publishing world. Advances in desktop publishing will cause advances in the image processing world. The current use of this technology is to capture previously produced documents and images, such as photographs, into electronic form for integration into new documents or for an alternative storage method. This is usually accomplished via Optical Character Reader (OCR). The major problem with this system today is the amount of time spent "proofing" the errors on documents entered by OCR. In some cases, it is a 3:1 ratio. (3 hours proofing for every 1 hour of reading) [13] The manpower time increases the overall cost of the technology. As more reliable scanners become available, the proofing time should decrease, making the systems more effective. As the existing base of documents are stored electronically, the need for massive duplicate reference libraries will decrease.

2. Recall. The technologies and techniques used in recalling stored data are closely aligned with the storage technologies. The majority of the recall systems today use either a sequential type search for an object or specially designed algorithms. Hypermedia has the ability to change this by being able to recall based on relations. [13] The advantages of hypermedia as a recall technology are the reduction of learning curve through simple interfaces, streamlining searches, effective communication of knowledge, stimulates retention, and adapts to distributed databases. There are some drawbacks to hypermedia. These are the technology is not mature, there will

have to be a culture change to accept the new technology, the installed hardware base is non-supportive, and currently not one systems has all the required capabilities. [15]

New and more complex object-oriented data bases are being built. New recall technology will increase the response time. These databases include image based systems. There is also a growing number of full-text retrieval systems. Previous full-text systems have been mainframe based and expensive. Newer PC-based systems are less expensive while providing nearly the same functionality. [16]

III. 1995 (Near Term)

A. Electronic Coordination

1. Electronic mail will be basically unchanged as a technology. However, there will be an increased number of users and a greater degree of connectivity than is present today. X.400 will be in place, but there will still be some proprietary systems. X.500 will be in place on a small scale, which will increase connectivity. [2] New applications will be developed that can take advantage of the power of electronic mail. Signature programs will run on top of electronic mail systems as a utility. Electronic mail will tie in with other applications, such as filing systems so that an individual can store messages or documents for future reference beyond today's mailbox-type applications.

2. Work Group. There will be a number of applications that can be used at this point. There will still be the connectivity limitations, but these will be decreasing as directory type services become available. Within a unit, or building, or (in some cases) a post, the work group applications will see increased use. Work group applications when coupled with strong electronic mail capabilities will help to increase coordination among different groups and make work groups more productive. [5]

B. Filing

1. Storage. Optical and magnetic methods for storing data will still dominate. The current trend of being able to store more for less will continue. The magnetic media will be more disk oriented as disk capacities increase past what can currently be stored on magnetic tape. It is predicted that 3.5" disks will have 100 Mbyte storage capacities. [17] This will occur because of new recording techniques, such as zone recording, and new materials being developed that can store up to 60,000 flux changes per inch (fcpi). Current systems are in the 17,000 fcpi range. [18] Cartridge-based magnetic tape

systems will be able to hold in the 2.6 Gbyte range. This will be based on improved tracking components, thinner substrate, higher coercivity pigments, smoother recording surfaces, and a decrease in size and number of surface defects. [6]

Optical storage will also increase as a storage media as the number of read-write optical disk drives increase. The media, like magnetic, will also be able to store more for less cost. Scanning and the use of optical character readers for direct input to optical storage will continue to grow.

Digital paper as a long term storage media will be cost effective. A reel capable of storing 1000 Gbytes of data will be available for approximately $2500. While the digital paper disk (1 Byte of storage) should be available in the $30 - 40 range. [12] The digital paper disk will be used in the workstation/PC environment and is capable of storing up to 1000 times as much as traditional optical methods. The major cost of digital paper systems will remain the cost of the readers. However, the readers should be less costly than the optical disk jukeboxes in use today. [12]

2. Recall. New and faster recall methods will be in place, although the dominate method will still be sequential. New hypermedia methods will be gaining ground as these technologies become more prevalent. The major change in this area will be in developing algorithms for recall data and information on distributed system. This will still be in its infancy at this time. The ability to recall and collect data from a variety of different systems will be the key to future information systems.

IV. 2010 (Long Term)

A. Electronic Coordination

1. Electronic mail. Electronic mail will not be a stand-alone application, but fully integrated in standard applications or as a standard overlay to the user's environment. The use of electronic mail will continue to increase as networks become fully connected. The use of accepted standards will make most proprietary systems obsolete.

2. Work Group. All applications at this point will be able to tie into other applications. Increase strides in the distributed data base area and connectivity with directory services will open up this area. There will be no clear distinction between the work group application and other applications, since all will be able to freely share data. Work group collaborations will be common place. As a whole these work groups will be more productive since numerous individuals that are spread over large geographical distances will be

able to share data and revisions with each other in a rapid manner.

B. Filing

1. Storage. The initial trends of more storage for less cost will continue. However, new technologies will have be employed for the magnetic media to continue its growth. There will be increasing use of optical over the magnetic media. The ability to predict the storage capacity for individual media is difficult, but the current trend of decreasing cost per storage unit should continue. Additionally, as more systems are distributed, local storage requirements may decrease as users are able to use data stored on servers or central machines, either locally or geographically distant.

2. Recall. By this time, massive recall algorithms will be in place to control the recall of data and information over a widely distributed system. The growth of parallel computing and faster microprocessors will make this possible. New applications will be able to recall information in a variety of media and present it to the user on multimedia-type workstations.

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From hengst@jackson Thu Mar 9 11:46:54 1989
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